

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
RESEARCH AND TECHNOLOGY RESUME

TITLE

Portable High-Speed Photometry Systems for Observing Occultations

PERFORMING ORGANIZATION

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DESCRIPTION (a. Brief statement on strategy of investigation; b. Progress and accomplishments of prior year; c. What will be accomplished this year, as well as how and why; and d. Summary bibliography)

a. Strategy: Because of their high spatial resolution, stellar occultations have proven extremely effective for learning about planetary upper atmospheres, asteroids, and planetary rings. Our ring orbit studies for Uranus have been particularly fruitful because we have been able -- through occultations -- to obtain data of high spatial resolution (~2km) at the rate of 1-2 times per year. Our occultation program at M.I.T. involves (i) identifying the scientific questions that can be answered by occultation events, (ii) predicting the zone of visibility for the useful events, (iii) maintaining and improving a set of portable high-speed photometric systems, (iv) obtaining the observations, and (v) reducing the data and interpreting the results.

b. Accomplishments: Our accomplishments during the past year include: (i) a comprehensive analysis of stellar occultation data to obtain an oblateness for Uranus at the 10 μ bar level of 0.0193 ± 0.0010 , a value consistent with the planet being in hydrostatic equilibrium and undergoing rotation at the period found by Voyager; (ii) establishing an upper limit of 0.004 km on the equivalent depth of 1986U1R from 2.2 μ m occultation data, which implies that this ring—unlike most other Uranian rings—is composed of micron-sized particles; (iii) the discovery of low-amplitude waves on the edges of the epsilon ring of Uranus; and (iv) the acquisition of several hundred CCD "strip scans," obtained over a period of 6 weeks at Mauna Kea for the purpose of generating a prediction for the stellar occultation by Pluto that occurred on June 9, 1988.

c. Anticipated Accomplishments: We are now analyzing the CCD strip scans, and, from the observed "wobble" of the center of light of the Pluto-Charon system with respect to its center of mass, we expect to establish the relative masses of the two bodies. Also we shall be continuing our analyses of the "four-day" occultation by Uranus in order to learn more about the "kinks" that we have found on the edges of the delta ring. From our multiple observations from Mauna Kea and Siding Spring, we hope to establish whether the kinks on the profile edges are caused by a wave on the edge of the ring or are a manifestation of a spiral density wave within the ring.

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d. Publications

Elliot, J.L.; Glass, I.S.; and French, R.G.: The Occultation of KME 17 by Uranus and its Rings. *Icarus* **71**, 91-102 (1987).

French, R.G.; Elliot, J.L.; French, L.M.; Kangas, J.A.; Meech, K.J.; and Ressler, M.E.: Uranian Ring Orbits from Earth-Based and Voyager Occultation Observations. *Icarus* **73**, 349-378 (1988).

French, R.G.; Jones, T.J.; and Hyland, A.R.: The 1 May 1982 Stellar Occultation by Uranus and the Rings: Observations from Mount Stromlo Observatory. *Icarus* **69**, 499-505 (1987).

Holberg, J.B.; Nicholson, P.D.; French, R.G.; and Elliot, J.L.: Stellar Occultation Probes of the Uranian Rings at 0.1 and 2.2 μm : A Comparison of Voyager UVS and Earth-Based Results. *Astron. J.* **94**(1), 178-188 (1987).

Millis, R.L.; Wasserman, L.H.; and French, R.G.: Observations of the 22 April 1982 Stellar Occultation by Uranus and the Rings. *Icarus* **60**, 176-184 (1987).